and after considerable difficulties the Cabane des Bosses was reached on August 18. The altitude of this station is 4400 metres. Work was commenced four days later, and precisely similar results obtained. The B group, which appears to consist of ten well-defined doubles when observed at Meudon, and was almost reduced to the last double at Grands-Mulets, had disappeared altogether.

These observations, in conjunction with those made last year between the Eiffel Tower and Meudon, those made by M. de la Baume Pluvinel at Candia during the annular eclipse of June 17, and those made in the laboratory at Meudon, definitely demonstrate the absence of oxygen from the sun, or, at least, of oxygen in the state that we know it.

M. Janssen thinks that, in the interests of astronomical and terrestrial physics and of meteorology, an Observatory should be established on the summit of Mont Blanc. The difficulties to be overcome in the erection of a station at such an elevation are great, but that they are not insurmountable is evidenced by the observations that have just been made.

Astronomy and Numismatics.—Dr. A. Vercoutre, in *L'Astronomie* for September, points out how astronomical knowledge may be of service to numismatical science. It is known that on many antique medals, and notably on the coins of the Roman Republic, stars and members of the solar system figure sometimes as symbols and sometimes as heraldic allusions to the magistrate by whom the coin was struck. Thus, on a coin struck by L. Lucretius Trio, 74 B.C., the seven stars in Ursa Major are shown, and this constellation, being named Septem Triones, was evidently used as a phonetic allusion to the surname (Trio) of the magistrate. Again, on a coin struck in B.C. 43, Dr. Vercoutre noticed five stars, one of which was much larger than the others. He therefore concluded that the constellation represented on the coin was Taurus, as this was the only group of five stars known to the ancients in which one was more brilliant than the others. On this account he was enabled to attribute the coin to P. Clodius Turrinus, who apparently used the constellation Taurus or Taurinus as a phonetic signification of his surname. A coin struck by Manius Aquillus, B.C. 94, has figured upon it the first four stars in the constellation Aquila. They are shown in nearly the same relative positions occupied in reality, hence the coin contains the oldest known representation of a portion of the celestial vault. It is therefore possible that an inspection of the stars figured on old coins may be the means of ascertaining the identity of the magistrate under whom they were struck, or, knowing this and the constellation represented, they may be useful for the determination of proper motion.

GEOGRAPHICAL NOTES.

M. Andrusoff, whose researches into the geological history of the Caspian Sea have been mentioned more than once in Nature, gives now some interesting preliminary results of his exploration of the Black Sea. After having carefully studied all that was previously known about that sea and embodied it in an excellent paper (published in the last issue of the *Izvestia* of the Russian Geographical Society, vol. xxvi., 2), he induced the Hydrographical Department of the Russian Navy to send out a special gunboat for the exploration of the Black Sea, under Captain Spindler and Captain Wrangel. The sea was thus carefully explored from Odessa to Constantinople, and thence to Batum and Sebastopol. It appears that great depths are found everywhere within a short distance of the shore; and that from a depth of 200 metres the water of the Black Sea begins to contain sulphuretted hydrogen resulting from the decomposition of decaying organisms, so that no organisms either vegetable or animal, are met with at depths exceeding 200 metres. The Black Sea, he concludes, is not a sea, properly speaking, but an immense stagnant pond (reaching a maximum depth of 1200 fathoms) which is covered on the surface by the water of the Mediterranean and the rivers which flow into it. The full report of M. Andrusoff is expected soon, and is sure to be full of interest.

A telegram, dated Tashkend, September 15, gives some extracts from a letter written by M. Grombchevsky on July 20, at Sel-kilian. The expedition had at last reached Tibet from the north; but the hostility of the ruler of Keria compelled them to undertake the journey too early in the spring. On May 21, they were on the Tibet plateau, but weather was most inclement at that time. Hard frosts (20° C. below zero), terrible snow-storms, and a complete want of water—the snow in the mountains not having yet begun to thaw—compelled the expedition to return to Kashgaria without having accomplished the proposed programme of exploration. Later on, the want of money prevented them from returning to Tibet in the summer. M. Grombchevsky also adds that the ruler of Kanjut has entered into vassal relations to the Government of India, and that the fort Shahidulla-hodja is occupied by a garrison of Kashmerees, thus commanding the drainage area of the Raskem-daria and its pasture grounds. Besides, in April last, the beck of Kanjut took possession of the Pamir and Dangarym-bash forts, formerly occupied by Chinese garrisons; so that the fort Pamir, which is now practically under English influence, and the Russian fort Kara-kul are separated by but a three days' march over a territory densely peopled with Kirghizes. We may thus expect that the veil which has for so many centuries concealed those regions from science will soon be entirely lifted, and Northern Tibet will become as well known as Central Asia.

"THE AGE OF SCIENCE."

On Friday evening last, Lord Derby, before distributing the awards of the Liverpool School of Science, delivered a clear, vigorous, and interesting address on some aspects of science. Ours, he said, would be remembered as pre-eminently the age of science. Our successors might excel us as writers, as politicians, as soldiers; they might surpass even the industrial energies of the present time, but it was not likely—it was scarcely possible—that in the region of science the twentieth century should witness advances greater than, or as great as, those of the nineteenth. The general experience of the world had been that brilliant but brief epochs of advance had been followed by long intervals of stagnation, and sometimes even of retrogression. Retrogression was not likely, but stagnation was quite possible. There was one phrase much employed when people talked on these subjects which, to his mind, contained a fallacy. He meant the common phrase of popularizing science. To popularize science was simply impossible. Anybody could cram up, with the help of an average memory and of easily acquired hand-books, a summary of what had been done in astronomy, in chemistry, or other sciences, but when that result was accomplished he would be very little nearer to any real gain which science could bring to him. It was only labour and perseverance, added to natural capacity, that could give a scientific mind. Some tincture of scientific knowledge was desirable for every educated person. The result might not be great, but the process was valuable. An entire absence of the scientific spirit was no doubt compatible with brilliant talent and high distinction. We did not find fault for a deficiency of that kind in a novelist, a poet, or a writer of light literature, but it was a deficiency notwithstanding. If asked what he meant by a scientific spirit, he thought he knew, but he must confess that it was more easily described in vague and general terms than precisely defined. He meant by it, in the first place, a habit of accuracy and exactness in matters of fact. In the next place, he meant that temper of mind which seeks for conclusions, but does not jump at them—which is equally opposed to the stupid incredulity of ignorance, refusing to accept any idea which is not familiar; to the reverential credulity which accepts as true any statement coming down from old or high authority; and to the careless indifferentism which, so long as a theory looks and sounds well, and especially if it flatters some previously existing feeling of prejudice, does not care on what foundation of reality that theory rests. That the world is governed by laws which we did not make and cannot abolish—laws which will operate whether we recognize or ignore them, and which it is our wisdom therefore to study that we may obey, and in obeying utilize them —that was what was taken to be the outcome of scientific teaching, and if anybody thought that a useless or an unimportant or unnecessary lesson he did not agree with him. Something else science, rightly understood, would teach us to know—what it is that we can hope to know and to understand; and to recognize how little that is, and how much lies, and probably always will lie, beyond the reach of our faculties. One word only he would add—that, having known men of many professions, he should say, as far as his observation went, the happiest lives were those which had been devoted to science. "Every step," said Lord

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Derby, "is interesting, and the success of those who do succeed is lasting. What general, what orator, what statesman, what man of letters can hope to leave a memory like that of Darwin? An invalid in health. a man who seldom stirred from home, a man until his later years very little known to the outer world, but who, from his quiet study, revolutionized the thought of Europe, and will be remembered as long as Newton and Bacon. If fame be ever worth working for—I do not say it is—that kind of fame is surely, of all, the most durable and the most desirable. Well, I have perhaps digressed from our proper subject, for it is not likely that we have a future Darwin in this room, but it is no exaggeration to say that, as a rule, no man who has taken to science as the work of his life regrets the choice, while men who have done important work in other lines feel like Renan, who, at the height of his literary eminence, tells us in his autobiography that he has often regretted that science, rather than historical research, had not been the object of his early pursuit."

MIMICRY.[1]

THE relationship of mimicry to other animal colours can only be explained by giving a short account of the latter.

I. The commonest use of colour is for concealment (*cryptic*), enabling an animal (1) to escape its enemies, or (2) to approach its prey. In these (1) protective (*procryptic*) or (2) aggressive (*anticryptic*) resemblances, animals seek concealment by a likeness to some object which is of no interest to enemies or prey respectively. Similar effects may be produced by the use of foreign objects with which the animal covers itself to a greater or lesser extent (*allocryptic*).

EXAMPLES.—(1) *Procryptic Colours.* A green pipe-fish (*Siphonostoma typhle*) conspicuous in the water, but well concealed among the leaves of *Zostera:* the brown lappet moth (*Gastropacha quercifolia*), conspicuous on a smooth deal board, but well concealed among dead leaves.

(2) *Anticryptic Colours.* A large frog (*Ceratophrys cornuta*) from tropical South America, which almost buries itself in a hole in the ground, while the head, which is exposed, harmonizes with the surroundings. In this position it waits till the small animals on which it feeds approach or even walk over it.

(3) *Allocryptic Colours.* A small English crab (*Stenorhynchus phalangium*) which decks itself with pieces of seaweed: another small English crab (*Hyas coarctatus*) was shown with and without its covering of pieces of seaweed (*Ulva*, &c.).

Mimicry is closely related to the colours illustrated above, but differs in that the animal resembles an object which positively repels its enemies or positively attracts its prey rather than one which is of no interest to either. It is better, therefore, to defer its consideration until after the description of the colours which form the models for mimicry.

II. The second great use of colour is to act as a warning or signal (*sematic colour*), repelling enemies by the indication of some unpleasant or dangerous quality (*aposematic* or *warning colours*), or signalling to other individuals of the same species, and thus assisting them to escape from danger (*episematic* or *recognition colours*). In a very interesting group of cases (*allosematic*), the animal warns off its enemies by associating with itself some other animal with unpleasant qualities and warning colours.

EXAMPLES.—(1) *Aposematic Colours.* The two unpalatable English moths (*Spilosoma urticæ* and *S. mendica*, female), when disturbed, assume attitudes which serve to display their conspicuous yellow and black colours. Portchinski has recently shown that an unpalatable European chrysalis (*Limenitis populi*) bears the most detailed resemblance to a chrysalis which has been pecked and rejected by a bird. The American skunks (*Mephitis mephitica*, *Conepatus mapurito*, &c.) possess the power of emitting an intolerable stench, and are extremely conspicuous black and white mammals.

(2) *Episematic Colours.* In the common rabbit the white tail serves as a beacon to other individuals, pointing the way to the burrow.

(3) *Allosematic Colours.* A hermit crab (*Pagurus bernhardus*) is commonly found with a sea anemone (*Sagartia parasitica*) attached to its shell; in another hermit crab (*Pagurus prideauxii*) the association is more constant, and the sea anemone (*Adamsia palliata*) is specialized for life on the shell of the crustacean. Two crabs (*Polydectus cupulifer* and *Melia tessellata*), described by Möbius in some of the islands round Madagascar, invariably held a sea anemone in each claw. Two other groups of animals, sponges, and ascidians, in addition to sea anemones, are avoided by the enemies of the Crustacea, and these are also made use of by the latter. Thus the hermit crab (*Pagurus cuanensis*) is found in shells which are covered with a (generally) brightly-coloured sponge (*Suberites domuncula*): Möbius also describes a hermit crab (*Ascidiophilus caphyræformis*) which lives in a case formed by an ascidian.

III. Mimicry may be defined as false warning or signalling colours (*pseudosematic*), repelling enemies by the deceptive suggestion of some unpleasant or dangerous quality (*pseudaposematic*) or attracting prey by the deceptive appearance of something attractive to them (*pseudepisematic*). Even foreign objects commonly associated with some well-defended and aggressive species may be mimicked by a comparatively defenceless form (*pseudallosematic*).

EXAMPLES.—(1) *Pseudaposematic Colours.* The various degrees of complexity with which protective mimicry occurs in insects was shown by examples of Indian and African Lepidoptera.

(*a*) Both sexes of the Indian *Papilio agestor* closely resemble the much commoner and nauseous butterfly *Euplœa tytia.*

(*b*) An Indian moth (*Epicopeia philenora*) similarly mimics an unpalatable butterfly (*Papilio protenor*), but in this case the male moth mimics the appearance of the male butterfly, and the female moth that of the female.

(*c*) If the mimicking species became common relatively to the mimicked, the deception would be liable to be detected. We therefore find that two or more models are often mimicked by the same species. Thus the male of the Indian *Elymnias leucocyma* mimics *Euplœa binotata*, while the female mimics the female of *Euplœa linnæi.* Both these Euplœas are also imperfectly mimicked by day-flying moths (*Amesia midama*). So also the male of the Indian *Papilio castor* mimics *Papilio chaon*, while the female mimics *Euplœa core:* in the south, *Papilio chaon* is absent, and BOTH sexes of the species (*Papilio dravidarum*) which represents *P. castor*, mimic *E. core.*

(*d*) Female butterflies are exposed to more dangers than the swiftly-flying males, and we find many instances in which the former are mimetic, although the latter are not. Thus the female of *Hypolimnas bolina* mimics *Euplœa core*, while the male is non-mimetic. The same is true of *Hypolimnas misippus*, the female of which mimics *Danais chrysippus.* Two forms closely allied to the latter (some regard them as merely varieties) are also mimicked by the former.

(*e*) The mimetic females also often resemble two or more different species of nauseous butterflies. Thus the female of *Papilio pammon* appears in two forms, mimicking respectively *Papilio hector* and *P. aristoloche;* while the females of *Euripus halitherses* (the male of which is probably mimetic) mimic *Euplœa rhadamanthus* and *Euplœa deione.*

(*f*) There are also striking examples in which the non-mimetic ancestor of a mimetic species has been preserved, *e.g.* in an adjacent island. Thus the female of *Elymnias undularis* mimics *Danais genutia* in Sikkim and North-East India; in Rangoon and Burmah there is a variety of the latter with white hind wings which is as common as the typical form, and the female of *E. undularis* is beginning to mimic this variety; in South India *E. undularis* is represented by *E. caudata,* in which the male is also beginning to mimic *D. genutia*, and the female is a more perfect mimic than in the other localities; in the Andaman Islands *E. cottonis* represents *E. undularis*, and both sexes appear to be non-mimetic, while *D. genutia* has never been recorded from this locality. A still more wonderful example is found in Africa and adjacent islands. *Papilio meriones* of Madagascar is non-mimetic, and the sexes are alike; the same is true of a closely-allied species, *P. humbloti*, recently discovered in Grand Comoro, and of *P. antinorii* recently found in Abyssinia. A very nearly related species in West Africa has a closely similar non-mimetic male, while two forms of female mimic *Danais chrysippus* and *Danais niavius.* In South Africa *Papilio cenea* has an almost identical male, while the females mimic *D. chrysippus*, the southern form of *D. niavius*, and two varieties of *D. echeria.*

(*g*) There are also examples which show us the origin of mimicry, in which the resemblance is very imperfect, but, nevertheless, sufficient to afford protection. The blue Euplœas of

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[1] Abstract of Lecture delivered by Edward B. Poulton, F.R.S., on Friday, September 5, at the Leeds meeting of the British Association.

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